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Effect of Different Stages of Umbel Picking on Seed Quality Parameters, Yield and Economics of Fennel

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***Abstract*—** *The fennel seeds with uniform size green colour and optimum fiber content are preferred by customer and have high demand in national as well as International Market with premium price. For this purpose, the present investigation was carried out at the Vegetable Research Farm, Department of Vegetable Science and Seed Science and Technology, Chaudhary Charan Singh Haryana Agricultural University, Hisar to find out the optimum stage at which umbel/seed should be harvested for maximum acceptable fiber content in seed. For this purpose seeds of all order umbels were harvested at 25,30,35,40,45,50,55 and 60 days after anthesis. The fiber content of seed irrespective of umbel order was found optimum when seeds/umbels were harvested at 30 and 40 days after anthesis but maximum net return was obtained at 40 days after anthesis stage. In case of other quality parameters i.e. test weight, germination percentage, seedling length; vigour index and yield were increased with each 5 days delay in harvesting after 40 days of anthesis.*

***Keywords*— Seed Quality, fennel seeds, vigour index, anthesis.**

I. INTRODUCTION

Fennel is one of the four most important seed spices which are grown on sizeable area. It is cultivated throughout the temperate and sub-tropical region of the world for its aromatic seeds, which are used as culinary spices. Fennel is cultivated as a garden or home yard crop throughout India up to altitude of 1825 m. In India, it is mainly cultivated in the state of Gujarat and Rajasthan and to some extent in Uttar Pradesh, Bihar, Madhya Pradesh, Punjab and Haryana. The fennel seed contains 0.7 to 6.0% pale yellow aromatic essential oil which has its use in cosmetics and medicines. The main constituent of oil in fennel is anethole (anise camphor) (50-70%). Green seeds with uniform size and free from chemical residues, bioagents or physical impurities and optimum fiber content are preferred by customer and have high demand in national as well as International Market with premium price.

II. MATERIALS AND METHODS

The present investigation was carried out at the Vegetable Research Farm, Department of Vegetable Science and Seed Science and Technology, Chaudhary Charan Singh Haryana Agricultural University, Hisar during 2003-2004. The area is situated at 29.10° N latitude and 75.46° E longitude at an elevation of 215.2 meters above the mean sea level where temperature below freezing point accompanied by frost during winter is common and average rainfall in this area is about 350-400 mm per annum which is unevenly distributed. Most of the rainfall is received during July to September along with few showers of cyclonic rains during winter and spring months. The soil of experimental field was low in organic carbon, medium in available phosphorus and high in potash with slightly alkaline in reaction. The seed of fennel variety HF-33 (Hisar Swarup) was sown in 3.0 x 2.4m plot size on 15th October. As per recommendation half dose of nitrogen i.e. 25 kg N/ha and full dose of phosphorus i.e. 25 kg P_2O_5/ha was applied at the time of sowing and remaining half dose of nitrogen was top-dressed in two equal split doses at one month interval. To find out the stage at which the umbel should be harvested/picked for better quality, twenty five umbels of each (main, primary and secondary) order umbel were tagged as and when flowers opened. The umbels were harvested as per the treatments i.e. 25, 30, 35, 40, 45, 50, 55, and 60 days after anthesis and these eight treatments were replicated thrice in randomized block design. Weeding, thinning and irrigation operations were carried out as and when required.

Fiber content was estimated by the method suggested by Gupta *et al.* (1992) and calculated with the following formula.

$$\text{Crude Fiber (\%)} = \frac{\text{Weight of crude fiber (D – E)}}{\text{Original weight of sample (B-A)}} \times 100$$

Where;

A= Weight of thimble
B= Weight of thimble and sample
D= Weight after drying
E= Weight after ashing.

The benefit cost ratio was calculated by the following formula:

$$\text{Benefit cost ratio} = \frac{\text{Gross return}}{\text{Total cost of production}}$$

III. RESULTS AND DISCUSSION

1. Test weight and Germination percentage

The test weight was same at 55 and 60 days (8.10, 6.70 and 4.78g in main, primary and secondary umbels, respectively) after anthesis which was statistically at par with 50 days in all order umbels. With each delay in harvesting, there was significant improvement in germination up to 60 days after anthesis in all the orders of umbels except from 50 to 55 days after anthesis for main order and 55 to 60 days after anthesis for secondary umbels. Maximum seed germination was recorded in main umbel seeds (94.6%) followed by 88.0 and 82.3 per cent in primary and secondary umbel seeds (Table 1).

2. Seedling length and Vigour index

The significant increase in seedling length was observed with each delay in harvesting up to 60 days after anthesis in main umbel seeds and upto 55 days after anthesis in case of primary and secondary umbel seeds (Table 2).

The vigour index was found zero at 25 and 30 days after anthesis there was no seed germination but after that with each 5 days delay in umbel picking/ harvesting it increased significantly up to 60 days after anthesis. Vigour index was highest at 60 days after anthesis and it was 1191.9, 941.6 and 798.3 in main, primary and secondary umbel seed, respectively. Test weight of seed from main, primary and secondary umbels was significantly influenced by stage of picking of umbel because seeds which were harvested early after anthesis was immature, under developed and under sized. They might have less stored food material, resulted in less or poor germination due to under developed embryo. However, seeds were bold which were harvested at later stage of umbel development. Such seeds showed better seed germination percentage even as compared with the standard. Bhati (1990) also reported increased test weight of seeds harvested at full grown seed turning yellow stage than half length seed in fennel. Seed harvested at 25 and 30 days after anthesis did not germinated at all. Late harvested seeds were significantly more vigorous as explained earlier.

3. Fiber content

The fiber content around 24 per cent is considered good for chewing fennel. When the main umbels were picked up 30 days after anthesis, the fiber content was 20.75 per cent which was statistically at par with 35 and 40 days. As regards, primary umbels (18.52, 19.15 and 19.17%) and in secondary umbels (19.10, 21.73 and 24.00%) optimum fiber content was found at 30, 35 and 40 days of anthesis (Table 3). After 40 days of anthesis, the crude fiber was higher than optimum rendering it unfit for chewing purpose. These results are in conformity with the results of Tiwari and Agarwal, 2004.

4. Seed yield (q/ha) and Economics

The seed yield as influenced by stage of umbels picking are presented in Table 3. The data revealed that seed yield increased with each delay in harvesting up to 55 days after anthesis but improvement in seed yield was significant up to 50 days after anthesis. However, the seed yield for chewing purpose depends upon fiber content of seed, for this purpose 30 to 40 days of anthesis was found optimum.

The economics of the different treatments as influenced by stage of umbels picking are presented in Table 4. The results clearly indicated that net return was highest when the umbels were harvested at 40 days after anthesis i.e. Rs. 67,379/ha with the benefit cost ratio of 4.57 followed by umbels picking at 35 days after anthesis. Umbels picked at 25 days after anthesis resulted into net loss of Rs. 18871 per hectare. The seeds/umbels harvested at 30 days after anthesis, yielded less, however, seeds were of good quality. When the umbels were harvested at 35 and 40 days after anthesis, the seed yield of 14.12 and 17.25 q/ha was obtained with acceptable fiber content and good attractive colour. After this stage, the seed lost their desirability of required colour and the fiber content i.e. 24 per cent (Tiwari and Agarwal, 2004). Higher net return as well as benefit cost ratio at 35 and 40 days stage was due to higher price of chewing fennel and also due to comparative good seed yield. Bhati (1990) indicated that maximum seed yield was obtained with umbel picking at full length green seed (12.26 q/ha) followed by full grown turning yellow seed (12.13 q/ha) and half-length seed (9.30 q/ha) whereas, umbel picking of half-length seed gave maximum net profit.

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IV. CONCLUSION

It is concluded from the present investigation that for obtaining better chewing quality fennel with optimum fiber content the umbel/seed should be harvested/picked 30-40days after anthesis but maximum net return Rs. 67,379 and benefit cost ratio 4.57 was obtained when umbels/seeds were harvested at 40 days after anthesis stage. Other seed quality parameters i.e. test weight, germination percentage, seedling length, vigour index and yield was found better at later stage of umbel harvesting i.e. 50,55 and 60 days after anthesis.

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Table.1: Effect of stage of umbels picking on test weight and per cent seed germination in fennel

Seed germination (%)			Test weight (g)			Treatments
Secondary umbel	Primary umbel	Main umbel	Secondary umbel	Primary umbel	Main umbel	
Days after anthesis						
0.0	0.0	0.0	2.10	2.76	3.50	25 days
0.0	0.0	0.0	2.95	3.52	4.32	30 days
29.6	32.6	28.3	3.40	4.70	5.90	35 days
37.6	50.3	43.6	4.05	5.98	7.35	40 days
61.3	62.6	65.6	4.50	6.35	7.70	45 days
70.0	74.3	80.3	4.70	6.50	7.98	50 days
79.3	84.3	86.0	4.78	6.70	8.10	55 days
82.3	88.0	94.6	4.78	6.70	8.10	60 days
5.6	3.1	6.5	0.21	0.25	0.31	C.D. at 5%

Table.2: Effect of stage of umbels picking on seedling length and vigour index-I in fennel

Vigour Index			Seedling length (cm)			Treatments
Secondary umbel	Primary umbel	Main umbel	Secondary umbel	Primary umbel	Main umbel	
Days after anthesis						
0.0	0.0	0.0	0.0	0.0	0.0	25 days
0.0	0.0	0.0	0.0	0.0	0.0	30 days
139.1	166.2	192.6	4.7	5.1	6.8	35 days
206.8	291.7	335.7	5.5	5.8	7.7	40 days
367.8	431.9	557.6	6.0	6.9	8.5	45 days
490.0	609.2	778.9	7.0	8.2	9.7	50 days
761.3	885.1	997.7	9.6	10.5	11.6	55 days
798.3	941.6	1191.9	9.7	10.7	12.6	60 days
27.7	15.4	8.37	0.4	0.3	0.6	C.D. at 5%

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Table.3: Effect of stage of umbels picking on seed yield (q/ha) and fiber content (%) in fennel

Fiber content (%)			Seed yield (q/ha)	Treatments
Secondary umbel	**Primary umbel**	**Main umbel**		
Days after anthesis				
12.13	12.18	14.70	8.25	25 days
19.10	18.52	20.75	10.12	30 days
21.73	19.15	21.17	14.12	35 days
24.00	19.17	22.44	17.25	40 days
31.06	24.33	25.65	19.12	45 days
33.91	29.34	29.52	19.50	50 days
34.20	34.36	31.60	19.87	55 days
34.57	35.01	33.62	19.87	60 days
3.35	2.43	2.51	0.72	C.D. at 5%

Table.4: Effect of stage of umbels picking on economics of fennel seed crop

Benefit cost ratio	Net returns (Rs./ha)	Cost of production (Rs./ha)	Gross income (Rs./ ha)	Selling price of seed (Rs./ kg)	Seed yield (q/ha)	Treatments
		Days after anthesis				
0	-18871	18871	0	0	8.25	25
1.60	11489	18871	30360	30	10.12	30
3.74	51729	18871	70600	50	14.12	35
4.57	67379	18871	86250	50	17.25	40
3.04	38489	18871	57360	30	19.12	45
2.58	29879	18871	48750	25	19.50	50
2.10	20869	18871	39740	20	19.87	55